What's New in Cardiovascular Surgery

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SUMMARY

Advances in the treatment of congenital cardiovascular lesions have led to a renewed interest in the treatment of acquired heart disease. Although this field could best be served by the perfection of the extracorporal heart, such devices are as yet not ready for human application. Meanwhile, various approaches through the ventricles and left atrium have been developed to treat valvular stenosis. Refinements in diagnostic tests and in methods of physiological investigation are of great aid in the proper evaluation of patients.

NOT long ago, Claude Beck, a pioneer in cardiac surgery, wrote: "Indeed, the time is not far off when operations upon the heart will be almost as common as operations upon the vermiform appendix."[3] This prediction has already been realized in some clinics. Furthermore, it is no longer an unusual circumstance to hear the heart discussed as an organ subject to surgical correction. This attitude has developed as a consequence of advances in the treatment of congenital cardiovascular malformations, which, in turn, stimulated a renewed interest in the development of techniques for the treatment of acquired heart disease.

The correct diagnosis and the proper evaluation of the abnormal function of the heart and great vessels at times is quite difficult. Physiologic investigations such as the measurement of the oxygen saturation of the blood in various parts of the vascular system, cardiac catheterization, angiocardiography, exercise tests, and electrocardiography are required. Above all, teamwork is essential in cardiovascular surgery, and the degree of success attained is dependent upon the combined skill and effort of all those involved in the diagnosis and treatment of these patients.

PATENT DUCTUS ARTERIOSUS

Since the first successful closure of a patent ductus arteriosus by Gross in 1938, the operation has had widespread acceptance. There is general agreement among cardiologists that a ductus which remains patent beyond the age of two or three should be closed, for the hazards of the ductus are greater than those of operative intervention.

The method of closing the ductus is not agreed upon by all cardiovascular surgeons. Thus Scott,[45] in reporting upon 180 patients operated upon at Johns Hopkins Hospital with five deaths and one recanalization, advocated the suture-ligature method of Blalock as being safer than division and suture. On the other hand, Gross,[26] Wangensteen,[52] and Potts[44] advocate division and suture. Jones,[36] in analyzing his experiences with 125 patients, gave a lucid description of the possible complication of the operation. There were four deaths in the series, and Jones concluded that there is not a "single, universally ideal technique" for the operative treatment of the ductus.

The author uses ligation more frequently than division. It is felt that if the ductus has been thoroughly mobilized so that it is possible to allow a space between the two or three braided silk ligatures there is little chance of recanalization.

CYANOTIC HEART DISEASE

The brilliant use of an artificial ductus arteriosus for the treatment of tetralogy of Fallot by Blalock and Taussig has been followed by numerous reports of its successful adoption by others.

In general, Blalock prefers not to operate before the age of two if the chances of survival to the age of two are 50 per cent or better.[8] He reported an over-all operative mortality rate of 17.7 per cent, but in those patients who survived a subclavian-to-pulmonary-artery anastomosis the mortality rate was 10.4 per cent. Potts[42] reported upon 181 patients. In most cases aortic-pulmonary artery anastomosis was carried out. The over-all mortality rate was 12.7 per cent, and in those who survived anastomosis it was 9.7 per cent. Paine and Varco,[40] and Holman,[32] advocate using the left subclavian artery in preference to the right subclavian artery.

Although experimental studies on venous shunts for complete transposition of the aorta and the pulmonary artery held some promise of success, the clinical application of these procedures, as reported by Blalock[10] and Hanlon,[29] was not very encouraging. Of the various operations, the best results followed the creation of the combination of an interatrial defect and an extracardiac arterial shunt.

It is not unlikely that certain anomalies of the pulmonary veins, particularly those in which most or all of the veins empty into the right atrium, may be improved by atriovenous shunts.[8, 12] Work in the surgical laboratory at Stanford University School of Medicine has demonstrated the feasibility of shunting large veins to the atrium, whereas small atriovenous shunts usually close by fibrosis.[21, 22] It is probable, therefore, that these procedures will be more successful in the older age groups, after growth of the veins has occurred.

Fell[19] and his associates have reemphasized the

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practicability of the Potts procedure of direct aorta-pulmonary artery anastomosis in the small infant. They used it, with dramatic improvement, in three children with tricuspid atresia all weighing less than ten pounds.

COARCTATION OF THE AORTA

Following the first successful operations for coarctation of the aorta by Crafoord,[16] and Gross,[28] several series of cases have been reported. Gross recently described his experiences with 100 cases.[25] In nine, resection of the aorta was not attempted. There were 11 deaths. Of the 80 patients who survived the completed operation, 71 had total relief of hypertension, and eight had fairly satisfactory relief. The group at Johns Hopkins Hospital have reported upon 23 patients.[5] Thirteen were 21 years of age or above, while 10 were younger. Anastomosis was completed in 21 cases, with three deaths for the whole series. Physiological observations indicated that the hypertension in coarctation probably is not caused by a renal pressor mechanism. A number of interesting associated anomalies have been encountered during these procedures. Shumacher[46] successfully contended with an aneurysm distal to the coarctation. Unilateral hypertension due to involvement of the origin of the left subclavian artery in the area of aortic atresia has been recorded.[20] An associated patent ductus arteriosus is found occasionally. Long segments of atresia which preclude direct end-to-end anastomoses have necessitated the use of preserved homografts,[27] and the left subclavian has also been used to bridge the gap.[33]

CHRONIC CONSTRICTIVE PERICARDITIS

In a recent survey of 265 recorded operations for constrictive pericarditis, Holman[3] found that 21 deaths occurred on the operating table, 48 deaths occurred in the early postoperative period, 118 patients were considered cured, and 44 improved. Pericardiectomy was performed upon nine patients, four of whom had active tuberculous pericarditis. Pronounced improvement was noted in eight cases. One patient died. Holman stressed adequate exposure through a median sternotomy and liberation of all borders of the heart, including both cavae. Experimental work by Parsons and Holman, now being completed, indicates that most of the signs of constrictive pericarditis can be reproduced by interfering with the filling of the right heart through the constriction of the cavae, or the right atrium and ventricle.

Oglesby[39] and his associates reviewed the case histories of 53 patients observed at the Massachusetts General Hospital since 1914. Hydrothorax and calcification of the pericardium occurred in about 50 per cent of the cases. In all, 42 patients were subjected to pericardiectomy; 15 of them were essentially cured, and ten improved. Six patients died from the effects of the operation. From the standpoint of etiology, it is of interest to note that tuberculous involvement was proven in only nine cases.

MYOCARDIAL ISCHEMIA

In a series of publications Beck[2, 4] has reported a new approach to the relief of coronary artery disease. In operations upon dogs, the carotid artery was anastomosed to the coronary sinus in an effort to revascularize the cardiac muscle. The measurement of benefit of the operation was made by ligating the descending ramus of the left coronary artery at its origin. In another group of animals a free vein graft was used between the aorta and the coronary sinus. There were more survivors among the animals which had the protection of the shunt. One patient was operated upon, but a fresh infarct developed and death ensued. This procedure calls for considerable operative skill and leaves unanswered many fundamental physiological questions concerning the flow of blood in the heart muscle. Vineberg[51] explored the possibility of implanting the internal mammary artery into the ventricular wall and found that, under experimental conditions at least, communications with the circulation of the coronary vessels took place.[51]

Carter[13] and his associates have restudied Lezius' method of producing a coronary collateral circulation by means of cardiopneumonopexy. In a series of experimental animals asbestos powder was used to produce vascular adhesions between the lung and the heart, and the effect of coronary artery ligation was observed. The collateral stimulated by the adhesions reduced the mortality and the frequency of severe infarction resulting from coronary ligation. The operation was done on three patients with benefit in two; the other died due to infection. In another experiment, Carter and MacMillan[14] reported their experiences in developing a technique for the excision of portions of the ventricles, and stated that the possible use of such a procedure might include the resection of small aneurysms and foreign bodies, as well as areas of necrotic myocardium which result from acute ischemia.

CONSTRICTIVE VALVULAR DISEASE

In the past few years there has been a great revival of interest in the surgical treatment of constrictive valvular disease. The ultimate goal in cardiac operations for this purpose is the repair of the valves under direct vision, but this must await the development of an extracorporal device which will maintain the circulation while the heart is opened. A number of laboratories are engaged in the perfection of such an artificial heart: Gibbon[23, 24] of Philadelphia, who has labored for years on this problem, has predicted the perfection of his apparatus in the near future; Björk[6] of Sweden, Jongbloed[35] of Holland, and Karlson and Dennis[37] and their associates of Minneapolis have all attained a degree of success with various types of machines. At present this work has reach the point at which medium-sized dogs can be maintained for several hours while the heart is opened.

Meanwhile, valvulotomy is being applied clinically in the treatment of valvular stenosis by a number of surgeons. Smithy[47] and associates used both

ventricular and auricular approaches to the stenotic mitral valve and removed a small segment of anterior cusp by means of a punch type of valvulotome. In a series of seven patients, eight operations were performed with two deaths. In four patients there was clinical improvement, and in one there was little change. Harken[30] prefers the approach through the left auricle and believes that one should strive for a minimum amount of regurgitation and a maximum restoration of valvular function by incision or excision in the zones of the commissures. He and his associates reported operations upon eight patients. There were five valvuloplasties with three deaths, two interatrial septal defects, and one cardiac denervation. Some improvement was noted in those who survived the operations.

Bailey[1] and his associates in Philadelphia have meanwhile developed an ingenious method of performing a valvulotomy through the left auricular appendage in which the index finger is used as a guide to feel the stenotic valve and also to direct a valvulotome to the proper position. They, too, stress cutting the commissures rather than the valve leaflets, believing that valvular action is preserved and regurgitation prevented. They have now done a moderate number of such operations and have reported good clinical improvement and a comparatively low mortality rate.

The observation by Lutembacher that patients with mitral stenosis and an atrial septal defect develop less pulmonary edema led Sweet and Bland[49] to postulate that a vent between the pulmonary venous and systemic venous circulations might prevent the pulmonary edema which occurs under stress in these patients. They performed an anastomosis between the superior segment branch of the inferior pulmonary vein and the azygos vein in six patients and noted pronounced clinical improvement in three.

Several years ago, Rundle and the author attempted to test the physiological effects on pulmonary hypertension of an azygos vein to pulmonary vein shunt in the experimental animal. The investigation was not completed because of lack of a method producing a high degree of mitral stenosis which would result in lasting pulmonary hypertension. It was learned, however, that small vein-to-vein anastomoses frequently thrombose, a result which was no doubt encouraged by the lack of a pressure differential that would ensure a free flow of blood through the shunt.

Patients with pure pulmonic stenosis do not benefit from the creation of an artificial ductus arteriosus, but are improved by transventricular valvulotomy as described by Brock.[11] Blalock and Brock[9] recently reported their experiences with this method. In 19 cases there were two deaths, and considerable improvement was noted in the survivors.

In 19 experiments on dogs Templeton and Gibbon[50] reported the successful replacement of the tricuspid valve for an excised one in seven animals. The operations were performed through the open right atrium. The grafts were made from pericardium and vein, the pericardium proving to be the superior tissue.

The production and repair of interatrial septal defects has been studied in experiments on animals. Hanlon and Blalock developed a method of producing small atrial defects,[29] and have reported their clinical results with its use in the treatment of transposition of the great vessels.[10] The direct approach through the open right atrium, with the cavae occluded, is being used to make large septal defects.[48] Having made openings by this means in a group of animals, Swan and his associates devised a method of invaginating the auricular appendages into the defect, and reported satisfactory closures. They claim an advantage over Cohn's method.[15] Dodrill devised a double ring instrument which clamped the atria, approximating the lateral walls against the septum.[17] This permits excision of a portion of the septum in a bloodless field, through an incision in the outer atrial wall.

Murray[38] has described a method of closing septal defects, which he developed on 30 dogs. It consists essentially of passing sutures through the heart in the line of the interatrial septum and pulling them taut to close the defect. He has reported its use in a few patients, with moderate improvement.

VESSEL GRAFTS

For many years, surgeons have sought a satisfactory method for bridging gaps in blood vessels which have been damaged by disease or trauma. Pioneers in this field 50 years ago were Carrel and Guthrie. With the increase in interest in cardiovascular surgery, the need for grafts has again been emphasized. Gross[27] and his co-workers have demonstrated tissue viability of segments of aorta stored in special media for 35 to 40 days, and have reported excellent early results with the use of experimental and human homografts. Autogenous vein grafts to replace defects in medium-sized arteries continue to be used and appear to function satisfactorily.[34] Donovan[15] found that homogenous vein grafts thrombosed when anastomosed to the heart.

The author has been interested in this problem for a number of years, and, among other things, has found that arterial homografts will conduct blood satisfactorily for long periods of time. However, pronounced degenerative changes frequently occur in the vessel wall soon after transplantation, and ultimately the graft is replaced by fibrous tissue, with very little retention of normal aortic wall structure.[41] Fatty changes and calcium deposition were a frequent finding in the grafts.

These results call attention to the fact that the immunological and other factors concerned in maintaining viability of the transplanted tissue in the host must be understood before the ultimate goal in surgery—the replacement of a diseased organ with one that is healthy—can be achieved.

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